

**What is claimed is:**

1       1. A method for preventing formation of photoresist  
2 scum, comprising the steps of:  
3           providing a substrate on which a dielectric layer is  
4           formed;  
5           forming a non-nitrogen anti-reflective layer on the  
6           dielectric layer; and  
7           forming a photoresist pattern layer on the non-nitrogen  
8           anti-reflective layer, wherein during the  
9           formation of the photoresist pattern layer, the  
10          non-nitrogen anti-reflective layer does not react  
11          with the photoresist pattern layer, thus not  
12          forming photoresist scum.

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1       2. The method as claimed in claim 1, further  
2 comprising forming an etching stop layer containing no  
3 nitrogen between the substrate and the dielectric layer.

1       3. The method as claimed in claim 1, wherein the non-  
2 nitrogen anti-reflective layer is a silicon-rich oxide  
3 layer.

1       4. The method as claimed in claim 1, wherein the non-  
2 nitrogen anti-reflective layer is a hydrocarbon-containing  
3 silicon-rich oxide layer.

1       5. A method for formation of photoresist scum,  
2 comprising the steps of:

3 providing a substrate on which a dielectric layer is  
4 formed;  
5 forming a non-nitrogen anti-reflective layer on the  
6 dielectric layer;  
7 forming a first photoresist pattern layer on the non-  
8 nitrogen anti-reflective layer, wherein during  
9 the formation of the first photoresist pattern  
10 layer, the non-nitrogen anti-reflective layer  
11 does not react with the first photoresist pattern  
12 layer, thus not forming photoresist scum;  
13 etching the non-nitrogen anti-reflective layer and the  
14 dielectric layer using the first photoresist  
15 pattern layer as a mask to form a via hole;  
16 removing the first photoresist pattern layer to expose  
17 the non-nitrogen anti-reflective layer surface;  
18 and  
19 forming a second photoresist pattern layer on the non-  
20 nitrogen anti-reflective layer, wherein during  
21 the formation of the second photoresist pattern  
22 layer, the non-nitrogen anti-reflective layer  
23 does not react with the second photoresist  
24 pattern layer, thus not forming photoresist scum.

1 6. The method as claimed in claim 5, further  
2 comprising forming an etching stop layer between the  
3 substrate and the dielectric layer.

1 7. The method as claimed in claim 6, further  
2 comprising forming a barrier layer between the etching stop  
3 layer and the dielectric layer to block a dopant in the  
4 etching stop layer from diffusing into the dielectric layer.

1       8. The method as claimed in claim 7, wherein the  
2 barrier layer is a silicon-rich oxide layer.

1       9. The method as claimed in claim 7, wherein the  
2 barrier layer is a hydrocarbon-containing silicon-rich oxide  
3 layer.

1       10. The method as claimed in claim 7, wherein the  
2 barrier layer has a thickness of 50 to 1000 Å.

1       11. The method as claimed in claim 7, wherein the  
2 dopant is nitrogen.

1       12. The method as claimed in claim 5, wherein the non-  
2 nitrogen anti-reflective layer is a silicon-rich oxide  
3 layer.

1       13. The method as claimed in claim 5, wherein the non-  
2 nitrogen anti-reflective layer is a hydrocarbon-containing  
3 silicon-rich oxide layer.

1       14. A method, comprising the steps of:  
2           providing a substrate on which an etching stop layer, a  
3           dielectric layer, a first barrier layer, and an  
4           anti-reflective layer are formed, wherein the  
5           first barrier layer blocks a first dopant in the  
6           anti-reflective layer from diffusing into the  
7           dielectric layer;  
8           etching the anti-reflective layer and the dielectric  
9           layer to form a via hole;  
10          forming a protective plug in the via hole;

11 forming a photoresist pattern layer on the anti-  
12 reflective layer, wherein the first barrier layer  
13 blocks the first dopant in order to prevent  
14 forming photoresist scum in the via hole; and  
15 etching the anti-reflective layer, the first barrier  
16 layer and the dielectric layer using the  
17 photoresist pattern layer and the protective plug  
18 as a mask to form a trench above the via hole,  
19 thus forming a dual damascene structure.

1 15. The method as claimed in claim 14, wherein the  
2 first barrier layer is a silicon-rich oxide layer.

1 16. The method as claimed in claim 14, wherein the  
2 first barrier layer is a hydrocarbon-containing silicon-rich  
3 oxide layer.

1 17. The method as claimed in claim 14, wherein the  
2 first barrier layer has a thickness of 50 to 1000 Å.

1 18. The method as claimed in claim 14, wherein the  
2 first dopant is nitrogen.

1 19. The method as claimed in claim 14, further forming  
2 a second barrier layer between the etching stop layer and  
3 the dielectric layer, wherein the second barrier layer  
4 blocks a second dopant in the etching stop layer from  
5 diffusing into the dielectric layer.

1 20. The method as claimed in claim 19, wherein the  
2 second barrier layer is a silicon-rich oxide layer.

1        21. The method as claimed in claim 19, wherein the  
2 second barrier layer a hydrocarbon-containing silicon-rich  
3 oxide layer.

1        22. The method as claimed in claim 19, wherein the  
2 second barrier layer has a thickness of 50 to 1000 Å.

1        23. The method as claimed in claim 19, wherein the  
2 second dopant is nitrogen.

1        24. The method as claimed in claim 14, wherein the  
2 stop layer is a silicon-rich oxide layer.

1        25. The method as claimed in claim 14, wherein the  
2 stop layer is a hydrocarbon-containing silicon-rich oxide  
3 layer.

1        26. The method as claimed in claim 14, wherein the  
2 protective plug is i-line photoresist.

1        27. The method as claimed in claim 14, further forming  
2 a third barrier layer on the anti-reflective layer.

1        28. The method as claimed in claim 27, wherein the  
2 third barrier layer is a silicon-rich oxide layer.

1        29. The method as claimed in claim 27, wherein the  
2 third barrier layer is a hydrocarbon-containing silicon-rich  
3 oxide layer.

1        30. The method as claimed in claim 27, wherein the  
2 third barrier layer has a thickness of 50 to 1000 Å.

1       31. A method of preventing formation photoresist scum  
2 for dual damascene process, comprising the steps of:  
3       providing a substrate on which an etching stop layer, a  
4       first barrier layer, a dielectric layer, a second  
5       barrier layer, an anti-reflective layer, and a  
6       third barrier layer are formed;  
7       etching the third barrier layer, the anti-reflective  
8       layer, the second barrier layer, the dielectric  
9       layer, and the first barrier layer to form a via  
10      hole;  
11      forming a protective plug in the via hole;  
12      forming a photoresist pattern layer over the anti-  
13       reflective layer, wherein the second barrier  
14       layer and the third barrier layers block a first  
15       dopant in the anti-reflective layer from  
16       diffusing into the dielectric layer and the first  
17       barrier layer blocks a second dopant in the  
18       etching stop layer from diffusing into the same,  
19       in order to prevent forming photoresist scum in  
20       the via hole; and  
21      etching the third barrier layer, the anti-reflective  
22       layer, the second barrier layer and the  
23       dielectric layer using the photoresist pattern  
24       layer and the protective plug as a mask to form a  
25       trench above the via hole, thus forming a dual  
26       damascene structure.

1       32. The method as claimed in claim 31, wherein the  
2 first barrier layer is a silicon-rich oxide layer.

1       33. The method as claimed in claim 31, wherein the  
2 first barrier layer is a hydrocarbon-containing silicon-rich  
3 oxide layer.

1       34. The method as claimed in claim 31, wherein the  
2 first barrier layer has a thickness of 50 to 1000 A.

1       35. The method as claimed in claim 31, wherein the  
2 second barrier layer is a silicon-rich oxide layer.

1       36. The method as claimed in claim 31, wherein the  
2 second barrier layer is a hydrocarbon-containing silicon-  
3 rich oxide layer.

1       37. The method as claimed in claim 31, wherein the  
2 second barrier layer has a thickness of 50 to 1000 A.

1       38. The method as claimed in claim 31, wherein the  
2 third barrier layer is a silicon-rich oxide layer.

1       39. The method as claimed in claim 31, wherein the  
2 third barrier layer is a hydrocarbon-containing silicon-rich  
3 oxide layer.

1       40. The method as claimed in claim 31, wherein the  
2 third barrier layer has a thickness of 50 to 1000 A.

1       41. The method as claimed in claim 31, wherein the  
2 first dopant is nitrogen.

1       42. The method as claimed in claim 31, wherein the  
2 second dopant is nitrogen.

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1           43. The method as claimed in claim 31, wherein the  
2 protective plug is i-line photoresist.